Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Alhagi maurorum* Medik. (USDA 2005)
Synonyms:	*Alhagi camelorum* Fisch., *Alhagi pseudalhagi* (Bieb.) Desv. ex B. Keller & Schaparenko (USDA 2005)
Common names:	Camelthorn
Evaluation date (mm/dd/yy)**:**	11/17/03
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List committee members:	12/17/03: W. Albrecht, W. Austin, D. Backer, J. Crawford, B. Phillips, K. Watters 02/17/04: W. Albrecht, W. Austin, D. Backer, J. Crawford, L. Moser, F. Northam, T. Olson, B. Phillips, K. Watters 04/16/04: W. Albrecht,, D. Backer, J. Crawford, H. Folger, J. Hall, R. Hiebert, F. Northam, T. Olson, K. Watters
Committee review date:	12/17/03, 02/17/04, and 04/16/04
List date:	02/17/04; revised 04/16/04
Re-evaluation date(s):	

Table 2. Scores, Designations, and Documentation Levels

Question		Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**B**	Observational	**"Impact"** **Section 1 Score:** **B**	**"Plant Score"** **Overall Score:** **Medium** **Alert Status:** **None**
1.2	Impact on plant community	**A**	Other published material		
1.3	Impact on higher trophic levels	**B**	Other published material		
1.4	Impact on genetic integrity	**D**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	Other published material	**"Invasiveness"** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **17 pts** **Section 2 Score:** **A**	
2.2	Local rate of spread with no management	**A**	Other published material		
2.3	Recent trend in total area infested within state	**B**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**B**	Other published material		
2.6	Potential for natural long-distance dispersal	**A**	Other published material		
2.7	Other regions invaded	**B**	Other published material		
3.1	Ecological amplitude	**A**	Other published material	**"Distribution"** **Section 3 Score:** **A**	RED FLAG **NO** Something you should know.
3.2	Distribution	**B**	Other published material		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Obs.**
Identify ecosystem processes impacted: *Alhagi maurorum* may cause moderate alteration of ecosystem processes related to water availability, erosion, and bank and dune stabilization.
Rationale: *Alhagi maurorum* has deep, penetrating, and massive roots that are opportunistic water users which decreases soil moisture making water less available to other plants (Kerr et al. 1965). Extensive root system can tap water up to 15m below surface (NAWC 2002). *Alhagi maurorum* may have an effect on erosion, in that it creates dense stands with a network of rhizomes on dunes and sandbars in areas that may otherwise not support a lot of vegetation, thus holding soils in place thereby stabilizing soils in areas that naturally migrate (floodplains, dunes, sandbars, etc.). This is most notable along rivers and waterways where *Alhagi maurorum* is well established in Arizona, especially in drainages, waterways and disturbed areas in the Holbrook and Winslow (Little Colorado River) and Colorado River areas. This also suggests contributions toward altered hydrological regime. It has also been suggested (B. Phillips, personal communication, 2004) that *Alhagi maurorum* may have effects on the nitrogen cycle in areas where it is dense, as it is a legume and likely has nitrogen fixing bacteria associated with its roots. However, there is no known documentation of this. Effects on soil salinity and alkalinity have been suggested but unknown or undocumented (Kerr et al. 1965). *Alhagi maurorum* acts as a sediment trap, which can be perceived as having both a positive and negative impact (B. Phillips, personal communication, 2004).
Sources of information: Score based on inference from the literature and observations. See cited literature. In addition to B. Phillips (Zone Botanist, U.S. Department of Agriculture, Forest Service, Coconino, Kaibab and Prescott National Forests, 2004), additional observations are by K. Darrow and F. Northam (Weed Biologist [former Arizona Department of Agriculture Noxious Weed Coordinator], Tempe, Arizona).

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: *Alhagi maurorum* can cause severe alterations of plant community composition.
Rationale: *Alhagi maurorum* forms dense stands that usurp space, light, nutrient, and water resources from other plant species. Where *A. maurorum* occurs in dense stands, its ability to uptake water due to its extensive root structure, gives it the ability to be highly competitive for resources. From observations of these dense stands, little other native vegetation is found (F. Northam, D. Backer). The deep and extensive root system allows *A. maurorum* to tap into water table up to 15 m below the surface (NAWC 2002). *Alhagi maurorum* also produces small amounts of litter (Kerr et al. 1965 and F. Northam, personal communication, 2004).
Sources of information: See cited literature; also see O'Connell and Hoshovsky (2000). Observations/personal communications are by B. Phillips (Zone Botanist, U.S. Department of Agriculture, Forest Service, Coconino, Kaibab and Prescott National Forests), F. Northam (Weed Biologist [former Arizona Department of Agriculture Noxious Weed Coordinator], Tempe, Arizona), and D. Backer (Conservation Ecologist, The Nature Conservancy, Tucson, Arizona).

Question 1.3 Impact on higher trophic levels *Score:* **B** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: Moderate alteration of higher trophic level populations, communities, or interactions. Has both positive and negative impacts on higher trophic levels.
Rationale: *Alhagi maurorum* is grazed by cattle, sheep, goats, [all non-native to this ecosystem] and bighorn sheep and mule deer, especially when young and tender; however, also may be harmful to some wildlife when mature and thorny. The vegetation is not palatable when mature but the seed pods are frequently browsed by cattle and horse (CDFA Undated, Kerr et al. 1965). *Alhagi maurorum* is also

recognized as an important honey plant in its native range, and was imported to southern Arizona in the 1920s for that purpose. Although not a natural setting, *A. maurorum* will take over croplands rendering the land useless for agriculture if not controlled.
Sources of information: See cited literature; also see O'Connell and Hoshovsky (2000) and NAWC (2002).

Question 1.4 Impact on genetic integrity	*Score:* **D** *Doc'n Level:* **Other pub.**
Identify impacts: No known hybridization.	
Rationale: No congeners exist in Arizona. No hybridization with other legumes has been documented (Kearney and Peebles 1960).	
Sources of information: See cited literature.	

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: *Alhagi maurorum* may occasionally establish in undisturbed areas but can readily establish in areas with natural and anthropogenic disturbances. Some level of disturbance is important for establishment, as is a natural or anthropogenic scarification of the seed. Invasion beyond areas of disturbance is minimal.
Rationale: *Alhagi maurorum* thrives on roadsides, agricultural fields (both anthropogenic disturbances), and along drainages where moisture is most available. Establishment is generally in disturbed areas that also receive a moderate amount of moisture. Thus, natural disturbances that are far from drainages, for instance, are not likely to be colonized.
Sources of information: See O'Connell and Hoshovsk (2000). Score rationale includes personal observations based on personal communications from November to December 2003: D. Evans (Range Specialist, U.S. Department of Agriculture, Forest Service, Prescott National Forest), T. Eckler (Arizona Department of Transportation), and M. Kearsley (Grand Canyon Research and Monitoring).

Question 2.2 Local rate of spread with no management *Score:* **A** *Doc'n Level:* **Other pub.**
Describe rate of spread: Increases rapidly, capable of doubling area of colonization in less than 10 years.
Rationale: *Alhagi maurorum* spreads primarily by rhizomes which can spread up to 20-25 feet from the parent plant another account is that rhizomes can grow up to 15 meter deep and up to 12 meters horizontally from the parent plant (various authors, see below). Infestations can spread at a rate of about 10 meters per year (CDFA Undated). Seeds and rhizome fragments are readily carried in drainages and subsequently establish along waterways. "In less than 20 years, the infestation along the canals near Gillespie Dam (Maricopa County) has become continuous for more than 15 miles" (Parker 1972). Rhizomes fragment easily and seeds have made there way from Winslow (thought to be the place of AZ origin in hay) into the Little CO River and to the Colorado River. Seedling growth is relatively slow (Kerr et al. 1965).
Sources of information: See cited literature; also see Kearney and Peebles (1960), O'Connell and Hoshovsky (2000), and NAWC (2002). An additional source is a personal communications with T. Eckler (Arizona Department of Transportation, 2003).

Question 2.3 Recent trend in total area infested within state *Score:* **B** *Doc'n Level:* **Obs.**
Describe trend: Increasing, but less rapidly than doubling every 10 years.
Rationale: *Alhagi maurorum* is found along highways, in agricultural areas, and in drainages throughout the state. However, the species is currently listed as a noxious weed in the state of Arizona, so there are concentrated efforts to eradicate it by the ADOT and in agricultural areas. Infestations and occurrences of camelthorn continue are moving south (and downstream) in Arizona (observational).

Sources of information: See Parker (1972), NAWC (2002), and Chambers and Hawkins (Undated). In addition, see USGS/Southwest Exotic Plant Information Clearinghouse, data for Grand Canyon National Park, available online at: http://usgssrv1.usgs.nau.edu/swepic/asp/aprs/. Additional sources are personal communications, November to December 2003: D. Evans (Range Specialist, U.S. Department of Agriculture, Forest Service, Prescott National Forest), T. Eckler (Arizona Department of Transportation), M. Kearsley, (Grand Canyon Research and Monitoring), B. Phillips (Zone Botanist, U.S. Department of Agriculture, Forest Service, Coconino, Kaibab and Prescott National Forests), and F. Northam (Weed Biologist [former Arizona Department of Agriculture Noxious Weed Coordinator], Tempe, Arizona).

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Other pub.**
Describe key reproductive characteristics: Sexual and asexual reproduction; seedlings rare; seeds germinate most readily after scarification or passing through digestive tract; will resprout easily from underground rhizomes if not fully removed.
Rationale: Begins flowering in May through July; pods persist until October or November (Parker 1972). Low percentage (~ 20%) of flowers set seeds (CDFA) and seeds remain viable in semi-arid soil for several years (NAWC 2002). Some points here differ from Joe DiTomaso's assessment for California in that California plants are relatively young and small and the populations in California have been mostly eradicated. (See Questions 2 and 3 on Worksheet A). Plants in Arizona are abundant and large by comparison, and therefore produce more seed, more frequently.
Sources of information: See cited literature; also see Kerr et al. (1965), O'Connell and Hoshovsky (2000), CDFA (Undated), and USGS/Southwest Exotic Plant Information Clearinghouse, data for Grand Canyon National Park (available online at: http://usgssrv1.usgs.nau.edu/swepic/asp/aprs/. An additional source is a personal communication with J. DiTomaso (Professor, University of California, Davis, 2003).

Question 2.5 Potential for human-caused dispersal *Score:* **B** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Hay, livestock and transportation corridors.
Rationale: Human dispersal occurs, not at a high level. *Alhagi maurorum* is sometimes accidentally transported in hay and in fill dirt from contaminated roadsides. Secondary human dispersal occurs when livestock eat contaminated hay or plants and disperse seeds in their manure. *Alhagi maurorum* can also spread along highways and canals. The species was originally introduced to the U.S. in packing material for date palms from its native Mediterranean region. In Arizona, *A. maurorum* is monitored through the USDA as a listed noxious weed, thus limiting its intentional dispersal by humans.
Sources of information: See O'Connell and Hoshovsky (2000) and NAWC (2002).

Question 2.6 Potential for natural long-distance dispersal *Score:* **A** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Potential for natural long-distance dispersal is high; frequent long-distance dispersal by animals or abiotic mechanisms.
Rationale: Transportation of seed in manure of grazers, seed remains viable after passing through digestive system; scarification either through digestion or by sand seems to be a necessary requirement for germination (Kerr et al. 1965). Transportation of seeds, rhizomes and rhizome fragments in drainages by water and by wind (CDFA Undated, NAWC 2002).
Sources of information: See cited literature; also see O'Connell and Hoshovsky (2000) and USGS/Southwest Exotic Plant Information Clearinghouse, data for Grand Canyon National Park (available online at: at: http://usgssrv1.usgs.nau.edu/swepic/asp/aprs/).

Question 2.7 Other regions invaded	*Score:* **B** *Doc'n Level:* **Other pub.**
Identify other regions: Invades in California in semi-desert grasslands and playas, 2 ecological types not invaded in Arizona (see draft California assessment by DiTomaso 2003). The species has spread throughout the desert southwest, into Washington, Idaho, Nevada, Utah, Arizona, Colorado, New Mexico, and Texas, as well as California (where it first introduced into the west [see authors in Kerr et al. 1965] has been effectively eradicated). It has also established in other countries outside of its native region, including South Africa and Australia.	
Rationale: *Alhagi maurorum* invades elsewhere on this continent and on other continents, but mostly in ecological types that it has already invaded in the state of Arizona. Grasslands and playas were colonized in California, but populations in these ecotypes have not been noted in Arizona. Although *A. maurorum* has been found in many ecotypes, many populations are restricted to roadsides, especially in Great Basin conifer woodland (pinyon-juniper), montane conifer forest (ponderosa pine), and on dunes. Kerr et al. (1965) reported that in Egypt, West Pakistan, Palestine, Nepal and India, *A. maurorum* stands occur on river terraces or flood plains where the water table was near the surface but where precipitation was relatively low. Based on studies in Washington, *A. maurorum* appears to be frost intolerant (Kerr et al. 1965).	
Sources of information: See cited literature; also see O'Connell and Hoshovsky (2000). Additional sources are personal communications, November to December 2003: D Evans (Range Specialist, U.S. Department of Agriculture, Forest Service, Prescott National Forest) and T. Eckler (Arizona Department of Transportation). Also considered the draft California plant assessment for *Alhagi maurorum* by J. DiTomaso (latest committee review date: August 1, 2003; available online at: http://www.caleppc.org).	

Question 3.1 Ecological amplitude	*Score:* **A** *Doc'n Level:* **Other pub.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: Widespread: the species invades at least three major and at least 5 minor ecological types in Arizona. *Alhagi maurorum* has colonized in Navajo, Coconino, Gila, Maricopa, and Yuma counties, from 100 to 5,000 feet in elevation. One focal point of introduction is Winslow, AZ, from where all drainages below there have been colonized. *Alhagi maurorum* was introduced to California in 1915 (various authors in Kerr et al. 1965). Introduced into southern Arizona in the early 1900's with the introduction of contaminated alfalfa and packing material from the Middle East.	
Rationale: Occurs in Navajo, Coconino, Gila, Maricopa and Yuma counties; 100 to 5000 feet in elevation (Parker 1972).	
Sources of information: See cited literature; also see Phillips et al. (1987) and NAWC (2002). Additional sources are personal communications: D. Evans (Range Specialist, U.S. Department of Agriculture, Forest Service, Prescott National Forest), T. Eckler (Arizona Department of Transportation), M. Kearsley (Grand Canyon Research and Monitoring), L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park Science Center, Flagstaff, Arizona), and B. Phillips (Zone Botanist, U.S. Deaprtment of Agriculture, Forest Service, Coconino, Kaibab and Prescott National Forests).	

Question 3.2 Distribution	*Score:* **B** *Doc'n Level:* **Other pub.**
Describe distribution: The distribution of *A. maurorum* is broad, being found all around the state of Arizona along streams, canals, roadways, and riparian corridors from 100 to 5000 ft. elevation.	
Rationale: *Alhagi maurorum* has infested somewhere between 20% and 50% of the LCR and Colorado river drainage system. Extensive in moist areas, especially in disturbed areas and where there is better runoff (roadside). Large areas of the Navajo Reservation are infested. Along a canal below Gillespie Dam in Maricopa County, there is a continuous infestation for 15 miles which grew in less than 20 years. Common from Winslow to Holbrook along I-40—what could see was mainly along I-40.	

Sources of information: See Parker (1972) and NAWC (2002). Additional sources are personal communications: D. Evans (Range Specialist, U.S. Department of Agriculture, Forest Service, Prescott National Forest), T. Eckler (Arizona Department of Transportation), M. Kearsley (Grand Canyon Research and Monitoring), L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park Science Center, Flagstaff, Arizona), and B. Phillips (Zone Botanist, U.S. Deaprtment of Agriculture, Forest Service, Coconino, Kaibab and Prescott National Forests).

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	**Yes**	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	**Yes**	**No**	**2 pt.**
Populations of this species produce seeds every year.	**Yes**	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	**Yes**	**No**	**1 pt.**
Seeds remain viable in soil for three or more years	**Yes**	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	**No**	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**Yes**	**No**	**1 pt.**
Fragments easily and fragments can become established elsewhere	**Yes**	**No**	**2 pt.**
Resprouts readily when cut, grazed, or burned	**Yes**	**No**	**1 pt.**

Total pts: 10 Total unknowns: 1

Score : A

Note any related traits:

Worksheet B. Arizona Ecological Types

(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	**D**
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	**B**
	Mohave desertscrub	**D**
	Chihuahuan desertscrub	**D**
	Sonoran desertscrub	**D**
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	**C**
	southwestern interior riparian	
	montane riparian	**B**
Woodlands	Great Basin conifer woodland	**D**
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	**D**
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

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